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NRL Memorandum Report 3623

Some Useful Procedures for FORTRAN Programming on the Advanced Scientific Computer

A. K. Jordan and R. H. Lang

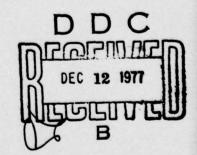*Aerospace Systems Branch*
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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The purpose of this report is to provide NRL research staff members with a brief, unified introduction to the Advanced Scientific Computer (ASC). It is written from the viewpoint of a research scientist (the user) who knows FORTRAN programming but who is not familiar with the complexities of the ASC and its Job Specification

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20. Abstract (Continued)

Language (JSL). It is intended to provide the simplest procedures necessary to "get on the machine, run FORTRAN programs, and get answers.

All of the procedures in this report have been used successfully by the authors. The programming consultants of the Research Computation Center contributed most of the information in this report. They are available to provide more detailed information than is given in this summary.

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CONTENTS

SOME USEFUL PROCEDURES FOR FORTRAN PROGRAMMING
ON THE ADVANCED SCIENTIFIC COMPUTER

I. FOREWORD

The purpose of this report is to provide NRL Research Staff members with a brief, unified introduction to the Advanced Scientific Computer (ASC). It is written from the viewpoint of a research scientist (the user) who knows FØRTRAN programming but who is not familiar with the complexities of the ASC and its Job Specification Language (JSL). It is intended to provide the simplest procedures necessary to "get on the machine", run FØRTRAN programs, and get answers.

All of the procedures in this report have been used successfully by the authors. The programming consultants of the Research Computation Center contributed most of the information in this report. They are available to provide more detailed information than is given in this summary.

Obviously, this introduction is neither unique nor complete; suggestions for improvements and additions are welcomed by the authors.

Demand for the first printing, issued as NRL Memorandum Report 3518, "An Introduction to FØRTRAN Programming for the Advanced Scientific Computer", has been great enough to justify a second edition. The authors have taken this opportunity to make several changes and additions, among which are:

1. The title has been changed to describe more accurately the purpose of this report.

2. The new system macro
    / KEYBØARD
    has replaced the old macro
    / MACASG S$,USERCAT/TERMINAL/MACRØS
    throughout this report. See Computer Note 137 for a detailed description with all the FØSYS options listed.

3. The new load and edit (LØED) command is used.

4. An example using a READ statement to input data for a FØRTRAN program has been added.

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A. References

For more detailed information, the user is referred to the following documents which are available from the Research Computation Center in Building A49.

1. Scientific Program Library User Manual for the Naval Research Laboratory; June, 1976.
2. ASC FØRTRAN Manual, Texas Instruments, Inc., #930055-2; Jan., 1976.
3. Job Specification Reference Manual, Texas Instruments, Inc., #930038-4; May, 1976.
4. ASC Keyboard Concentrator System User's Manual, Texas Instruments, Inc., #934732-2; May, 1976.
5. NRL Computer Notes 103 & 110.
6. CIFER, Card Image File Editor, Texas Instruments, Inc., #930032-1; Oct., 1974.

B. Notation Used in This Report

A simple program is short with few--if any--short subroutines. It is filed sequentially.

A complex program contains many long subroutines. It is partitioned into its various members and filed as a library (PD) file.

In the following programs, information written in lower case is to be supplied by the user.

Comments on the programming procedures are written in lower case and are indented from the actual program listing.

All listings begin in Column 1 and spaces--or lack of spaces-- must be typed as given.

The account number, user code, and password are established with the Research Computation Center on their application forms. (See Computer Note #107.)

The job name (usually the user's last name) designates the alphabetical bin in which output is placed at the Work Control Center.

For convenience, the author's division (D79) and branch (B40) are used in these programs. The user must change these to the appropriate numbers.

The FØRTRAN program name can contain 6 alphabetic characters.

Catalogue maintenance is described in Reference 3, Chap. 7. Also defined are file, node, pathname, version.

Macro is described in Reference 3, Chap. 9.

Alphabetic "O" (Oh) is written "Ø"
Numeric "0" (Zero) is written "0"
Alphabetic "I" (Eye) is written "I"
Numeric "1" (One) is written "1"

Ⓒ̲ᴿ means Carriage Return: implied if not written at end of line.

Ⓢ means simultaneously pressing Control key and S key: this is sign-on

Ⓒ means Control C: this terminates the previous command

Ⓣ means Control T and tabs six spaces for the beginning of a FØRTRAN command: implied for FØRTRAN commands

Ⓧ means Control X: this is sign-off and is implied if not written at end of session

C. Block Diagram of ASC Remote Keyboard Terminal System
(Reference 4)

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II.   ASC REMOTE KEYBOARD TERMINAL PROCEDURES

A.   Simple Programs

1.   Sign on and CReate a Program (see Reference 4)

   If the ASC remote terminal uses an acoustic coupler,
   then first extension 75904 is dialed and when the tone
   is heard the telephone handset is put into the acoustic
   coupler.

Ⓢ

   computer responds

accountno.,usercode,password   ⓒ︎ⓡ

   computer responds

jobname   ⒸⓇ
CR,programname

   Type FØRTRAN program
   To correct minor typing errors, press RUBOUT key

Ⓒ

   The program is STored from the local keyboard computer
   memory to the ASC disc.

ST,programname
L,A

   Program is listed for review.

2.   Execute a Program and Print Output at Remote Terminal

        Wait for computer response after typing these commands.
        A special set of JSL macros is called upon so that the
        user can interact with the main ASC through the remote
        keyboard terminal.

    / KEYBØARD
    / FTNLX IN=programname

        The ASC compiles and executes the FØRTRAN Program. A
        special file in the memory, FT06F001, is used for the
        PRINT output of all FØRTRAN programs. The file FT06F001
        is LØaded from the ASC to the local keyboard computer
        memory. (See Appendix.)

    LØED,FT06F001
    L,A

        We List All the file FT06F001 by EDiting it. FT06F001
        contains the output of the program. Any programming
        errors and diagnostic messages will be printed now--if
        compiling and link editing are successful.

3.   Example: Calculation of Chebyshev Polynomials

(S)
accountno.,usercode,password   (CR)
jobname
CR,CHEBYS
(T)   PRØGRAM CHEBYS
C   THIS PRØGRAM CALCULATES THE CHEBYSHEV
C   PØLYNØMIALS TN(X)=CØS(N*ARC CØS X)
      X=0.50
      DØ 10 N=1,5
      T=CØS(N*ARCØS(X))
      PRINT 20,N,X,T
   20 FØRMAT(5X,'N=',I4,2X,'X=',F7.4,2X,'TN(X)=',F10.7)
   10 CØNTINUE
      STØP
      END

(C)
ST,CHEBYS
L,A

      Program is listed

/ KEYBØARD
/ FTNLX IN=CHEBYS
LØED,FT06F001
L,A
      Output is listed
(X)
      Computer responds
(X)

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4.   Execute a Program and Print Output at Work Control Center

        Follow procedure of paragraph 2. (See Appendix.)
        After / FTNLX IN=programname type

/ FØSYS SYS.PRT
/ FØSYS FT06F001

        Output will be printed at both ASC Work Control Center
        and at remote terminal.

5.   Catalogue a Program from Remote Terminal to ASC.
      (See Computer Note 99.)

        Follow procedure of paragraph 1, then type.

PD,MY,USERCAT/D79/B40/usercode

        Note: MY is a synonym for the pathname
               USERCAT/D79/B40/usercode

/ CAT MY/programname,ACNM=programname

        Follow procedure of paragraph 2, for example.

6.   Repetitive Editing and Executing of Programs

This program gives the procedure for the repetitive
editing (making correction, adding new commands, etc.)
to a program already catalogued on the ASC.

Ⓢ
accountno.,usercode,password
jobname
/ KEYBØARD
PD,MY,USERCAT/D79/B40/usercode
AS,programname,MY/programname,USE=SHR
LØ,programname
→ ED,programname

Edit and correct program: The many keyboard commands
are given in the appendices of Reference 4.

ST,programname
L,A

program is listed.
When this procedure is used repetitively, the next
command, / REL etc., should be omitted for the first
execution (since there is nothing to RELease).
This command must be used on subsequent execution to
release the files FT06F001,SYS.ØMØD,SYS.LMØD,SYS.PRT,
so they can be used again.

/ REL FT06F001,SYS.ØMØD,SYS.LMØD,SYS.PRT
/ FTNLX IN=programname

This RELease command should be omitted on the first
execution.

RE,FT06F001
LØED,FT06F001
L,A
Output is printed
This procedure may be repeated until final program is
obtained.
Go back to ED,programname to repeat procedure.
The final version of the program will now be catalogued
to RePLace the original Version.

/ RPLV MY/programname,ACNM=programname

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7.   Enter Data from a Keyboard Terminal

          After editing is completed, as in paragraph 6, type

      ST,programname
      CR,INPUT

          type input data: READ statement must be in FØRTRAN
          program

      Ⓒ
      ST,INPUT

          The command   / FTNLX IN=programname of paragraph 6 is
          changed to:

      / FTNLX IN=programname,DATA=INPUT

          continue as before

8.   Catalog Status of a User's Program

      Ⓢ
      accountno.,usercode,password
      jobname
      CS,USERCAT/D79/B40/usercode,LIST=VANS

          a user's files catalogued under this pathname are listed

9.   Catalog Status of Other User's Program

      LIMIT USCØ=otherusercode
      CS,USERCAT/D79/B40/otherusercode,LIST=VANS

10.   Punch Deck of Cards for Program Stored on ASC Disc

          The program to be punched is assumed to have been STored
          on the ASC disc, as in Paragraph 2.

      / FØSYS programname,TYPE=PUNCH

          cards will be punched out at RCC.

11. Example: Calculation of Chebyshev Polynomials Using READ
             Input Data

Ⓢ
accountno.,usercode,password   ⓒⓡ
jobname
CR,CHEBYD
Ⓣ   PRØGRAM CHEBYD
C   THIS PRØGRAM CALCULATES THE CHEBYSHEV
C   PØLYNOMIALS TN(X)=CØS(N*ARC CØS X)
          DØ 30 I=1,3
          READ 5,X
       5 FØRMAT (5X,F7.4)
          DØ 10 N=1,5
          T=CØS(N*ARCØS(X))
          PRINT 20,N,X,T
      20 FØRMAT(5X,'N=',I4,2X,'X=',F7.4,2X,'TN(X)=',F10.7)
      10 CØNTINUE
      30 CØNTINUE
          STØP
          END

Ⓒ
ST,CHEBYD
L,A

       Program is listed

CR,INPUT
       0.50 ⎫
       1.0 ⎬ Formatted data
       0.25 ⎭

Ⓒ
ST,INPUT
/ KEYBØARD
/ FTNLX IN=CHEBYD,DATA=INPUT
LØED,FTO6FO01
L,A

       Output is listed

Ⓧ
       Computer responds
Ⓧ

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B. Complex Problems

1. Sign-on Procedure

Ⓢ
accountno.,usercode,password
jobname

> Note: The security classification is assumed to be
> UNCLASSIFIED.

/ KEYBØARD
SE,terminalsectors,ASCsectors,CPtime

> Note: This command SEts aside extra disc memory space
> for long, complex programs.

>> terminalsectors = no. of sectors for remote
>>   terminal
>>   lower limit = 3125 (default value)
>>   upper limit = 32767
>> ASCsectors = no. of sectors reserved on ASC
>>   lower limit = 5120 (default value)
>>   upper limit = 128000
>> CPtime = Central Processor time in seconds
>>   (default value = 60 secs.)

User may have to wait for computer response
(SET=ØKAY); simple programs can be created now,
however.

If the program is already catalogued on the ASC, use
procedure of paragraph 3.

If the program is to be CReated and then CATalogued,
use procedure of paragraph 2.

2. Create and Catalog Programs

    Follow procedure of paragraph 1. Then type

CR,programname

    Type FØRTRAN program
    Note: It is good practice to CALL R$STØP, an ASC
    debugging aid (see Computer Note #94) before the first
    executable FØRTRAN command.

(C)
ST,programname
PD,MY,USERCAT/D79/B40/usercode
/ CAT MY/programname,ACNM=programname

    Note: It is good practice to print out a Job Activity
    (JA) after commands ST, / CAT, PD, AS, etc. to see if
    they worked. See Reference 4.
    Now follow procedure of paragraph 4.

3. List Catalogued FØRTRAN Program

    Follow procedure of paragraph 1. Then type

PD,MY,USERCAT/D79/B40/usercode
AS,PDFILE$$,MY/programname,USE=SHR
LØED,programname

    Note: Here we are using some complex--but very
    useful--catalog maintenance procedures; see Reference 3,
    Chap. 7 or the RCC consultants.
    Here we let programname = membername of file.
    Also note that PDFILE$$ is the only name that can be
    used for Partitioned Direct Secondary (PDS) files.

L,A

    program is listed

ST,programname

    Now follow procedure of paragraph 4.

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4. JSL Macro for Repetitive Executing and Cataloguing

> This procedure is typed once only. See Reference 6.
> A set of JSL commands, which are used repeatedly, are
> combined into the macro we call JSL. After procedures
> of paragraphs B.1 and B.2 *or* B.1 and B.2 type

```
CR,JSL
/ REL FT06F001,SYS.ØMØD,SYS.LMØD,SYS.PRT.
/ CIFER
<<CØPY programname,PDFILE$$/programname
<<MERGE PDFILE$$,SEQN
/ FD FT06F001,BAND=4/12/4
/ FTNLX IN=SEQN,FTNØPT=(K),FTVERS=FX
Ⓒ
ST,JSL
```

> Note: Either the FX compiler (FTVERS=FX) or the NX com-
> piler can be used here. The authors have found the FX
> compiler to be more convenient for problems requiring
> complex arithmetic. The optimizing compiler, NX, is
> useful for large production runs.

5. Repetitive Editing, Executing, and Cataloguing

> The procedure of paragraph 4 need only be performed
> once. Then type

➤ AP,JSL

> Omit this RElease command for the first execution.

```
RE,FT06F001
LØED,FT06F001
L,A
```

> Output is listed

```
ED,programname
L,A
```

> Program is listed.
> Modifications may be made.

```
ST,programname
```

> Go back to AP,JSL and repeat until final program is
> obtained.

III.   ASC PUNCHED CARDS FOR COMPLEX PROGRAMS

1.   Execute a FØRTRAN Program on ASC

```
/ JØB jobname,accountno.,usercode,ØPT=(C,D,R)
/ FTNLX ØPT=(I),FTNØPT=(K)

    FØRTRAN source deck

/ EØJ
```

2.   Catalog Complex Program on ASC

```
/ JØB same as above
/ PD,MY,USERCAT/D79/B40/usercode
/ CATN MY/programname
/ CIFER
<<SPLIT *,SØURCE

    source deck

/ CATV MY/programname,ACNM=SØURCE
/ EØJ
```

3.   Punch a Duplicate Deck of Cards

```
/ JØB same as above
/ FØSYS SYS.IN,TYPE=PUNCH,CØPIES=n

    Deck to be punched (less than 3200 cards)
    Note:  One copy is punched unless CØPIES = n is added
    after PUNCH; n = no. of copies

/ EØJ
```

4.   List Deck of Cards

```
/ JØB same as above
/ FØSYS SYS.IN

    Deck to be listed (less than 3200 cards)

/ EØJ
```

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5.   Convert CDC FØRTRAN Deck to ASC Format

    / JØB same as above
    / PD DICK,USERCAT/D42/B20/MCGIR1/LØAD
    / ASG SYS.LMØD,DICK,USE=SHR
    / FXQT ØPT=(Z,A),CPTIME=3000

        1   0   1   1

        Deck to be converted

    E
    / REL SYS.LMØD
    / FTN FTNØPT=(X,M),IN=FT07F001,FTVERS=FX
    / FØSYS FT07F001,TYPE=PUNCH
    / LNK
    / FXQT ØPT=(Z,A),CPTIME=3000

        Data cards, if any

    / EØJ

6.   List User's Catalogued Files

    / JØB same as before
    / CATLST CPØPT=(A,B)
    7USERCAT usercode 4
    USERCAT D79   B40   usercode
    / EØJ

7.   Enter Data in FØRTRAN Program

    / JØB same as before
    / FTNLX ØPT=(I),DATA=INPUT

        FØRTRAN Source deck (READ Statement)

    / START ACNM=INPUT

        Data Cards

    / STØP
    / EØJ

IV. Appendix: Block Diagram of FTNLX Macro
Rectangular blocks are files.
Elliptical blocks are machine functions.

```
                    ┌─────────────┐
                    │  Compiler   │─────────────────────────────┐
                    └──────┬──────┘                             │
                           │                                    │
                           ▼                                    ▼
              ┌─────────────────────┐              ┌─────────────────────┐
              │      SYS.ØMØD       │              │      SYS.PRT        │
              │  Relocatable object │              │    Compilation      │
              │       module        │              │      listing        │
              └──────────┬──────────┘              └─────────────────────┘
                         │
                         ▼
                 ┌─────────────┐
                 │ Link Editor │──────────────────────────────┐
                 └──────┬──────┘                              │
                        │                                     │
                        ▼                                     ▼
              ┌─────────────────────┐              ┌─────────────────────┐
              │      SYS.LMØD       │              │      SYS.PRT        │
              │  Relocatable load   │              │     Link-edit       │
              │       module        │              │      output         │
              │  Ready to execute   │              └─────────────────────┘
              └──────────┬──────────┘
                         │
                         ▼
                  ┌─────────────┐
                  │    FXQT     │
                  │ Execute load│
                  │   module    │
                  └──────┬──────┘
                         │
                         ▼
           ┌────────────────────────────────┐
           │ Printed Output:   FT06F001      │
           │ Punched Output:   FT07F001      │
           └────────────────────────────────┘
```

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